



## The role of dairy consumption in weight management



**T**he prevalence of overweight and obesity is increasing worldwide. The most recent national figures for South Africa indicate that one in every five women have a body mass index  $\geq 35.0$  kg/m<sup>2</sup> and that the prevalence of obesity/overweight in men and women is close to 31% and 68%, respectively.<sup>1,2</sup> The association between chronic lifestyle diseases and obesity is well known<sup>3</sup> and ischaemic heart disease, hypertension and diabetes mellitus currently rank among the top 10 leading causes of death in South Africa.<sup>4</sup> It follows that interventions that affect any of these components should have a general positive outcome on overall health.

### Association between the intake of dairy products and weight management

There appears to be conflicting information regarding the effect of calcium intake on weight management. This can be ascribed to various factors, including the type of studies performed, duration of intervention and the source of calcium.

- Cross-sectional studies typically indicate an inverse association between calcium intake and weight gain,<sup>5-7</sup> cohort studies tend to yield inconclusive findings<sup>5</sup> and both positive and negative associations have been found in randomised controlled trials (RCTs).<sup>5,6,8,9</sup>
- Positive effects are generally seen in short-term studies (<12 months), which may be due to better compliance during short-term interventions.<sup>8</sup>
- Dietary calcium, which comes mainly from dairy products, has a more pronounced effect than supplemental calcium.<sup>5-10,11</sup> This suggests that components other than calcium in dairy products also contribute to weight loss.<sup>7</sup>

A number of meta-analyses of RCTs have been performed to determine the association between dairy consumption and body weight when distinguishing between high (550–1000 mg per day) and low calcium intake (290–800 mg per day). Abargouei et al.<sup>5</sup> reported higher dairy intake to be associated with a slight loss in body weight (–0.61 kg) and fat mass (–0.72 kg). However, considerable heterogeneity was found among the analysed studies. When grouping studies

according to energy restriction, they found that high calcium intake coupled with energy restriction (on average –500 kcal per day) was significantly associated with a higher loss in body weight (–1.29 kg) and fat mass (–1.11 kg), a reduction in waist circumference (–2.43 cm) and an increase in lean body mass (0.72 kg).<sup>5</sup> Chen et al.<sup>8</sup> similarly reported that the combination of a high calcium intake and energy restriction resulted in weight loss (–0.79 kg) and loss of fat mass (–0.94 kg); however, the losses were significant only when the intervention was shorter than 12 months.<sup>8</sup> In another meta-analysis, Geng et al.<sup>9</sup> confirmed the importance of energy restriction in achieving weight loss associated with dairy intake. A high dairy intake (at least three servings per day) coupled with energy restriction (–500 kcal per day) resulted in a significant decrease in body weight (–0.64 kg), fat mass (–0.56 kg) and waist circumference (–2.18 cm).

In an individual RCT, Jones et al.<sup>12</sup> reported that in an energy-restricted diet, the greater weight loss seen in participants with a high calcium intake (1400 mg per day) compared with those with a low calcium intake (700 mg per day) could be ascribed to their increased feeling of satiety and subsequent lower fat intake.<sup>12</sup> However, contrasting results have also been reported, with no difference in appetite experienced by participants who consumed at least three servings of dairy per day compared with those who consumed less than one serving per day.<sup>13</sup>

The inverse association between calcium intake and body weight has been found for women across all age groups. Over a four-year observation period, women with a below-average calcium intake had a considerably higher chance for being overweight (odds ratio = 2.25) than those with an above-average calcium intake, who, in fact, experienced significant weight loss. Every 100 mg calcium increase was associated with an 0.8 kg difference in body weight.<sup>14</sup> The linear association between calcium intake and weight loss was confirmed when another study showed weight loss to increase linearly with an increase in calcium intake (400–500 mg vs 800 mg vs 1200–1300 mg per day).<sup>15</sup> Energy restriction (–500 kcal per day) applied to all groups.

Heaney et al.<sup>16</sup> suggested an increase of 300 mg in daily calcium intake to be associated with a difference of 2.5–3.0 kg in body weight, based on their review aimed at determining the effect size of calcium on weight loss reported in published studies. Similarly, a drop in body mass index (from 25.6 kg/m<sup>2</sup> to 24.7 kg/m<sup>2</sup>) has been reported to be associated with calcium intake increasing from 400 mg to 1200 mg per day.<sup>7</sup> A potential threshold of 600–800 mg dietary calcium was proposed, with enhanced fat loss seen above this level.<sup>7</sup> The effect appears to be more pronounced if calcium is obtained from dairy foods as opposed to from calcium supplements.<sup>11</sup>

Although all participants of the Framingham Heart Study cohort gained weight during follow-up, annual weight gain increments were 0.10 kg smaller in those who consumed at

least three servings of total dairy per day compared with those consuming less than one serving per day.<sup>17</sup> This finding held also for yoghurt intake, but not for any of the other dairy products. An inverse association between weight gain and yoghurt intake has also been reported in a study that showed participants consuming more than seven servings of yoghurt per week to gain less weight than those who consumed two servings per week. The authors also reported that participants with a higher yoghurt intake were more active and consumed more fruit. The combination of higher yoghurt and fruit intake lowered the risk of overweight even more.<sup>10</sup> Healthier dietary habits were also reported in a study in which milk consumption was found to be inversely related to the consumption of sugar-sweetened beverages.<sup>8</sup>

An energy threshold effect was also reported to be associated with the effect of dietary calcium on body weight. At an energy intake below 1876 kcal per day, calcium is the main contributing factor to changes in body weight and body fat. However, beyond this level, total energy intake was the main predictor of outcome.<sup>18</sup>

When trying to understand the contradictory findings reported in the literature, it is important to recognise the intricate interaction between dairy products and body weight. By choice, overweight individuals can deliberately consume low-fat dairy options in an attempt to reduce energy intake. However, this will unfortunately also result in a decreased calcium intake. One of the proposed mechanisms through which dairy affects food intake is early satiety, which is difficult to control for in observational studies.<sup>7</sup> In contrast, intervention studies that did not control for energy intake showed no change in body weight associated with calcium intake. This could be considered a positive finding, as dairy intake did not appear to increase body weight; however, dairy intake also did not contribute to weight loss as expected. It is possible that the true weight loss associated with dairy was masked because individuals had higher energy intakes when consuming dairy.<sup>7,8</sup> Therefore, for intervention studies investigating increased calcium/dairy intake to comment effectively on the association with weight loss, an energy-restriction component should be included. Studies that showed positive outcomes on weight loss had the following in common: individuals were overweight/obese at onset,<sup>6,7</sup> calcium intakes were habitually low before intervention (<600 mg per day)<sup>6,7</sup> and caloric deficits (–500 kcal per day) were maintained throughout the study period.<sup>5,6,8,9,12</sup>

### Possible mechanisms of action

Effective intervention against obesity would need to affect body weight either directly (increase weight loss or decrease weight gain) or indirectly (reduce appetite and food intake or impair absorption). Various mechanisms are known to contribute to the association between dairy/calcium intake and body weight maintenance.

An increased calcium intake helps to reduce fatty acid absorption owing to increased binding of calcium to faecal fat. This forms insoluble soaps and leads to decreased binding of bile acids, which reduces micelle formation. Together, these effects ultimately lead to increased fat excretion.<sup>8,9,19</sup>

Dietary calcium also influences adipocyte calcium concentration, which alters adipocyte fat metabolism. An inadequate dietary calcium intake triggers the release of calcitropic hormones such as parathyroid hormone and 1,25-dihydroxyvitamin D. The latter increases adipocyte calcium concentration and results in increased lipogenesis, decreased lipolysis and decreased fat oxidation, which will result in fat retention and weight gain. Conversely, an

increased dietary calcium intake will trigger the reverse action and result in increased lipolysis and decreased fat accumulation.<sup>7-11,15,19,20</sup>

The dairy proteins casein and whey are known to suppress appetite<sup>7,19</sup> and increase satiety.<sup>9,19,21</sup> Whey suppresses food intake soon after consumption (within approximately 90 minutes), whereas casein's effect is seen later (about 150 minutes after consumption).<sup>7</sup> Casein and whey are also involved in lowering blood pressure<sup>7,22,23</sup> and lowering blood glucose through insulinotropic action.<sup>7,13,23,24</sup> The latter enhances lipoprotein lipase activity, which contributes to triglyceride clearance.<sup>23</sup>

## Conclusion

*Obesity has become a major public health concern and every effort should be made to address this epidemic. Increasing dietary intake of calcium to at least three servings of dairy per day and reducing energy intake by 500 kcal per day appear to yield positive outcomes with regard to weight management in overweight/obese individuals who habitually have a low calcium intake. The positive impact of dairy on body weight is thought to be due to its inducing early satiety, reduced fat absorption, increased fat breakdown and reduced fat accumulation.*





## References

1. National Department of Health (NDoH), Statistics South Africa (Stats SA), South African Medical Research Council (SAMRC), and ICF. South Africa Demographic and Health Survey 2016, Key indicators report. Pretoria, South Africa, and Rockville, Maryland, USA: NDoH, Stats SA, SAMRC, and ICF, 2018
2. Shisana O, Labadarios D, Rehle T, et al. South African National Health and Nutrition Examination Survey (SANHANES-1). Cape Town: HSRC Press, 2013.
3. Gregg EW, Shaw JE. Global health effects of overweight and obesity. *N Engl J Med*. 2017; 377(1):80-81.
4. Msemburi W, Pillay-van Wyk V, Dornington RE, et al. Second national burden of disease study for South Africa: Cause-of-death profile for South Africa, 1997–2010. Cape Town: South African Medical Research Council, 2014.
5. Abargouei AS, Janghorbani M, Esmailzadeh A. Effect of dairy consumption on weight and body composition in adults: A systematic review and meta-analysis of randomized controlled clinical trials. *Int J Obes*. 2012; 36(12):1485-1493.  
<http://dx.doi.org/10.1038/ijo.2011.269>
6. Van Loan M. The role of dairy foods and dietary calcium in weight. *J Am Coll Nutr*. 2009; 28(1):120-129.
7. Dougkas A, Reynolds CK, Givens ID, Elwood PC, Minihane AM. Associations between dairy consumption and body weight: A review of the evidence and underlying mechanisms. *Nutr Res Rev*. 2011; 24:72-95.
8. Chen M, Pan A, Malik VS, Hu FB. Effects of dairy intake on body weight and fat: A meta-analysis of randomized controlled trials. *Am J Clin Nutr*. 2012; 96:735-747.
9. Geng T, Qi L, Huang T. Effects of dairy products consumption on body weight and body composition among adults: An updated meta-analysis of 37 randomized control trials. *Mol Nutr Food Res*. 2018; 62(1):1-10.
10. Martinez-Gonzalez MA, Sayon-Orea C, Ruiz-Canela M, De la Fuente C, Gea A, Bes-Rastrollo M. Yogurt consumption, weight change and risk of overweight/obesity: The SUN cohort study. *Nutr Metab Cardiovasc Dis*. 2014; 24(11):1189-1196.  
<http://dx.doi.org/10.1016/j.numecd.2014.05.015>
11. Zemel MB. Role of calcium and dairy products in energy partitioning and weight. *Am J Clin Nutr*. 2004; 79(5):907-912.
12. Jones KW, Eller LK, Parnell JA, Doyle-Baker PK, Edwards AL, Reimer RA. Effect of a dairy- and calcium-rich diet on weight loss and appetite during energy restriction in overweight and obese adults: A randomized trial. *Eur J Clin Nutr*. 2013; 67(4):371- 376.  
<http://dx.doi.org/10.1038/ejcn.2013.52>
13. Hollis JH, Mattes RD. Effect of increased dairy consumption on appetitive ratings and food intake. *Obesity*. 2007; 15(6):1520-1526.
14. Davies KM, Heaney RP, Recker RR, et al. Calcium intake and body weight. *J Clin Endocrinol Metab*. 2000; 85(12):4635-4638.
15. Zemel MB, Thompson W, Milstead A, Morris K, Campbell P. Calcium and dairy acceleration of weight and fat loss during energy restriction in obese adults. *Obes Res*. 2004; 12(4):582-590.
16. Heaney RP, Davies KM, Barger-Lux MJ. Calcium and weight: Clinical studies. *J Am Coll Nutr*. 2002; 21(2):152S-155S.
17. Wang H, Troy LM, Rogers GT, et al. Longitudinal association between dairy consumption and changes of body weight and waist circumference: The Framingham Heart Study. *Int J Obes*. 2014; 38(2):299-305.  
<http://dx.doi.org/10.1038/ijo.2013.78>
18. Lin Y, Lyle RM, McCabe LD, McCabe GP, Weaver CM, Teegarden D. Dairy calcium is related to changes in body composition during a two-year exercise intervention in young women. *J Am Coll Nutr*. 2000; 19(6):754-760.
19. Rozenberg S, Body JJ, Bruyère O, et al. Effects of dairy products consumption on health: Benefits and beliefs – a commentary from the Belgian Bone Club and the European Society for Clinical and Economic Aspects of Osteoporosis, Osteoarthritis and Musculoskeletal Diseases. *Calcif Tissue Int*. 2016; 98(1):1-17.
20. Zemel MB, Shi H, Greer B, Dirienzo D, Zemel PC. Regulation of adiposity by dietary calcium. *FASEB J*. 2000; 14:1132-1138.
21. Tian S, Xu Q, Jiang R, Han T, Sun C, Na L. Dietary protein consumption and the risk of type 2 diabetes: A systematic review and meta-analysis of cohort studies. *Nutrients*. 2017; 9(9):982.
22. Josse AR, Atkinson SA, Tarnopolsky MA, Phillips SM. Increased consumption of dairy foods and protein during diet- and exercise-induced weight loss promotes fat mass loss and lean mass gain in overweight and obese premenopausal women. *J Nutr*. 2011; 141(9):1626-1634.
23. Bjørnshave A, Hermansen K. Effects of dairy protein and fat on the metabolic syndrome and type 2 diabetes. *Rev Diab Stud*. 2014; 11(2):153-166.
24. Turner KM, Keogh JB, Clifton PM. Dairy consumption and insulin sensitivity: A systematic review of short- and long-term intervention studies. *Nutr Metab Cardiovasc Dis*. 2015; 25(1):3-8.  
<http://dx.doi.org/10.1016/j.numecd.2014.07.013>

Please visit our website for more evidence-based reviews on dairy nutrition and health.  
**[www.rediscoverdairy.co.za](http://www.rediscoverdairy.co.za)**



**www.DAIRY GIVES YOU GO**  
**rediscoverdairy**  
.co.za